Global Gateway

SWM Webinar Series

Large Infrastructure Investments in the Global South

Topics Overview

Welcoming remarks.

1. **Conceptual Introduction.**
   - What are large infrastructure investments in SWM?
   - Large investment needs and priorities.

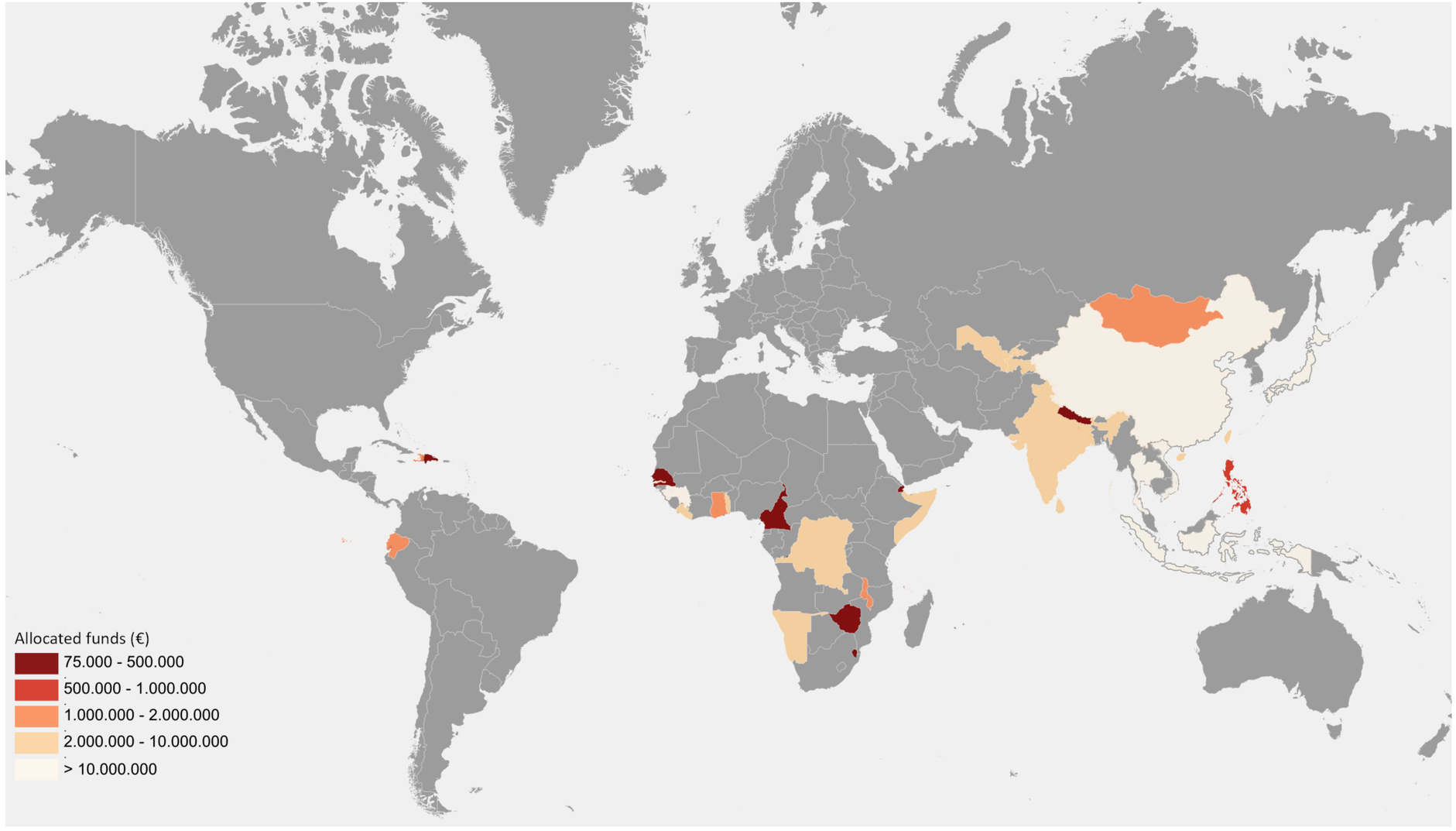
2. **Deep dive: Focus on Technical Aspects.**
   - Technical systems and facilities
   - Data and planning
   - Costs
   - What does success rely upon?

3. **Ask the Expert Session.**

Recycling of organic matter into compost, 2021, Sonfonia/ratoma composter, Conakry, Guinea. Sanita villes propres, a European Union project implemented by Enabel (Belgian development agency).)

Overview of INTPA SWM projects

Cameroon
China
Comoros
Congo D.R.
Djibouti
Dominican Rep.
Ecuador
Eswatini
Gambia
Ghana
Guinea, Rep.
Haiti
India
Indonesia
Japan



Liberia
Malawi
Mongolia
Namibia
Nepal
Philippines
Senegal
Singapore
Somalia
Sri Lanka
Tajikistan
Thailand
Togo
Vietnam
Zimbabwe

Overview of Urban Development Facility (UDTF) missions on SWM

Country	Topic
Guinea Conakry	Quick assessment of current program through stakeholders' workshop
Guinea Bissau	Diagnostic for program definition
Angola	Diagnostic for AD preparation
Mauritania	Recommendations for implementation plan of new SWM law
Zambia	Engagement and training for private sector – CE/waste valorisation
Cameroun	Formulation of SWM action – focus on plastic waste
Jamaica	Diagnostic for AD preparation
SSA	Analysis of presence of EU private sector

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Conceptual Introduction

Large infrastructure investments in SWM

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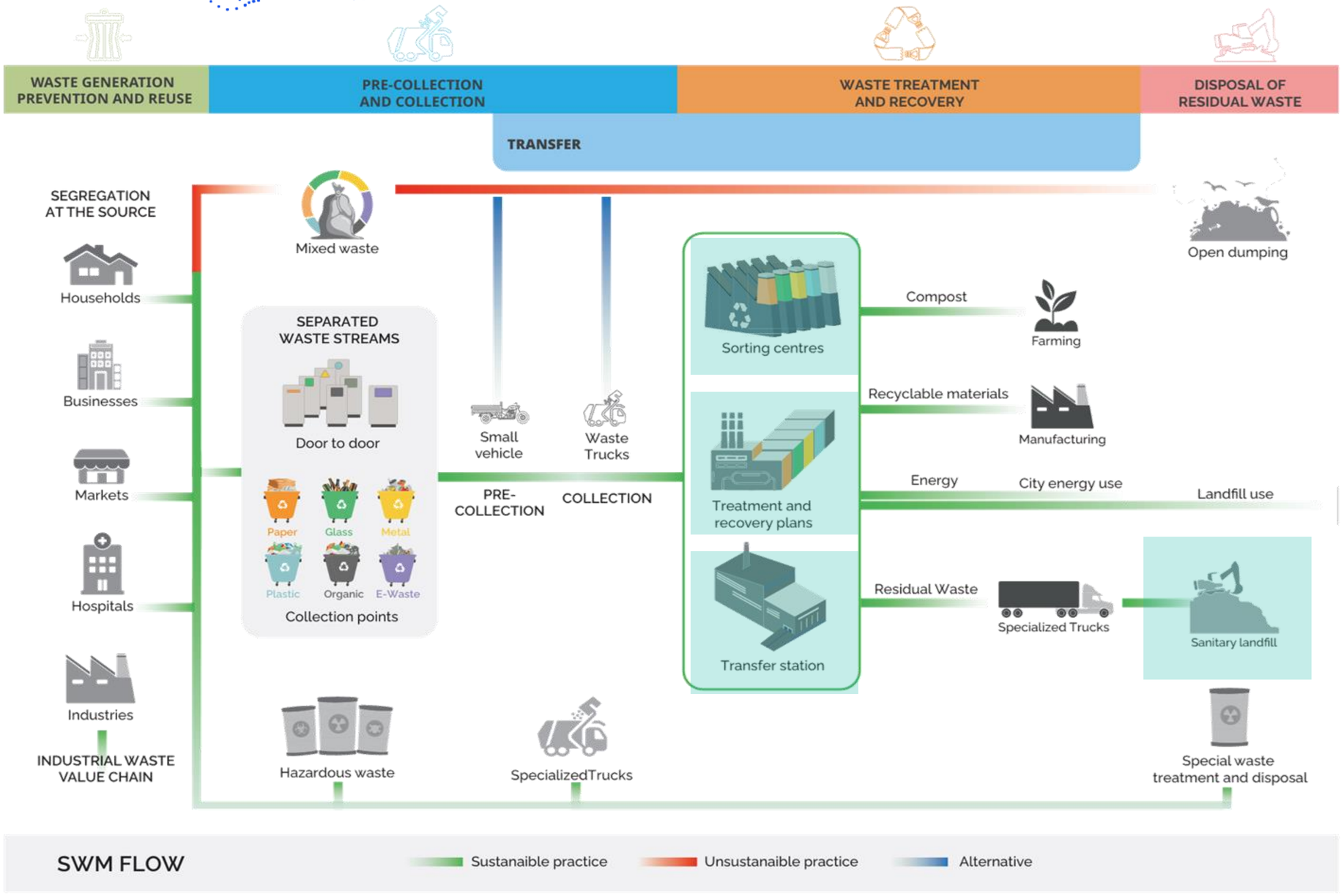
50Kg compost sacs, 2021, Conakry, Guinea. Sanita villes propres, a European Union project implemented by Enabel (Belgian development agency).

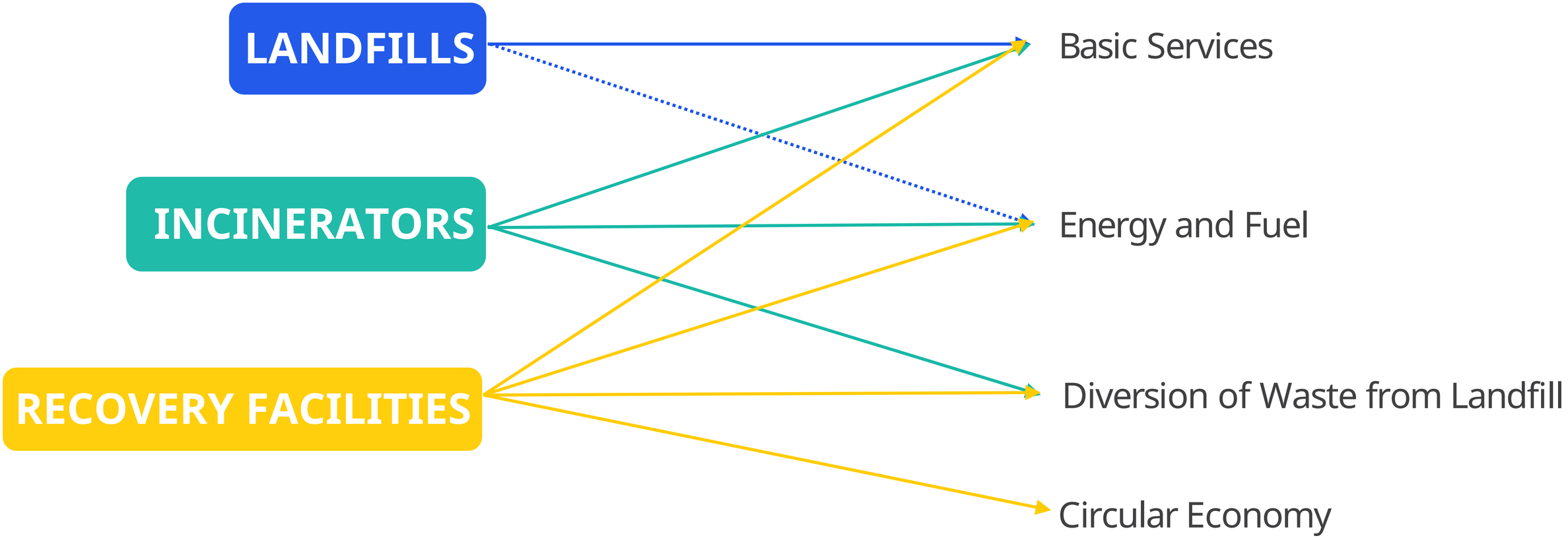
Large Infrastructure Investments in SWM are strategic for providing a failsafe for city health, environment and economic prosperity.

Large Infrastructure Investments are materialized in facilities towards the end of the SWM service/value chains.



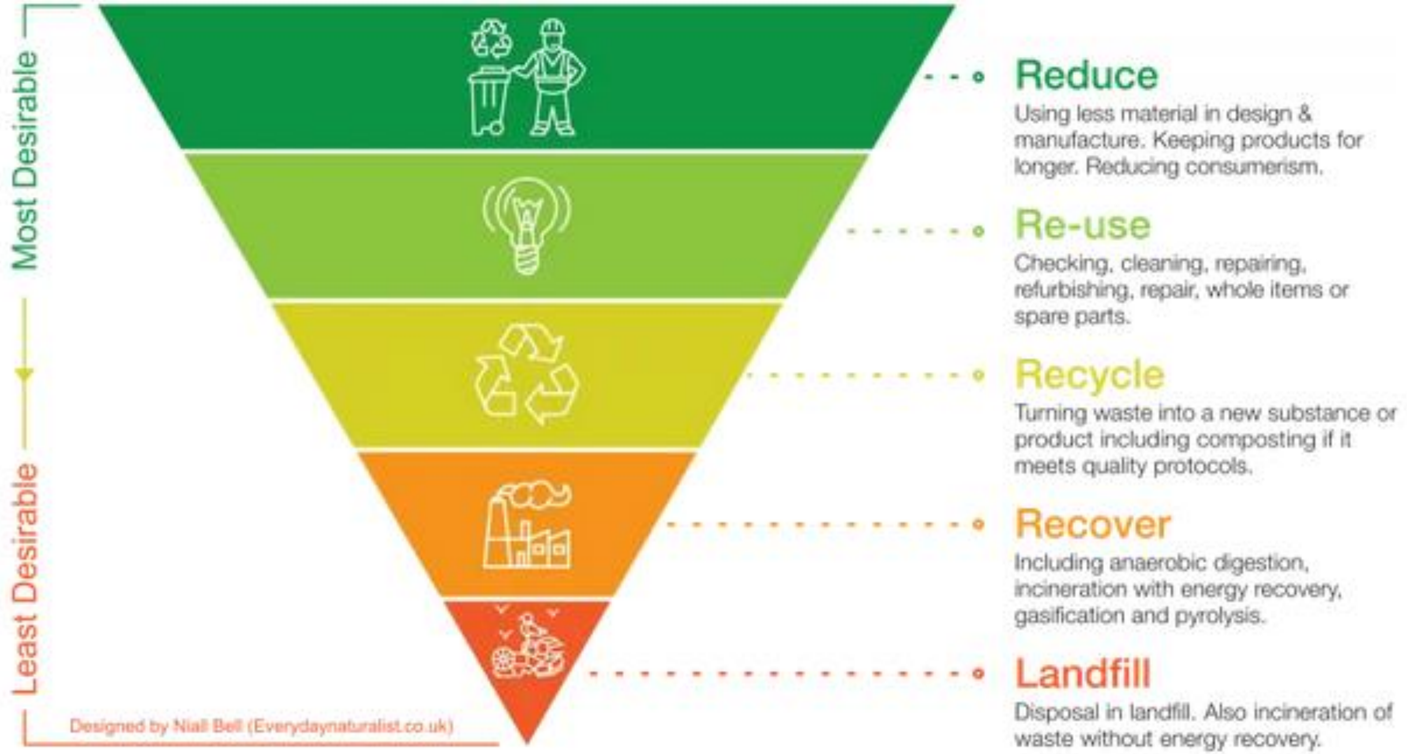
Source: INTPA F4, UDTF (2024). SWM Practical Advice Paper.

Large Investment Types



Large Investments considering the Waste Hierarchy

- **Large Infrastructure Investments** in SWM usually appear as an **end of pipe technology** and should only happen after reduce-reuse-recycle activities have been successfully implemented.
- **Landfills are** in case **necessary but should be reduced** as much as possible, in number and size.
- **Waste-to Energy** plants should also **only come when nothing else** has turned out to be **feasible or** in case of very **large daily waste quantities** (a couple of thousand of tons).

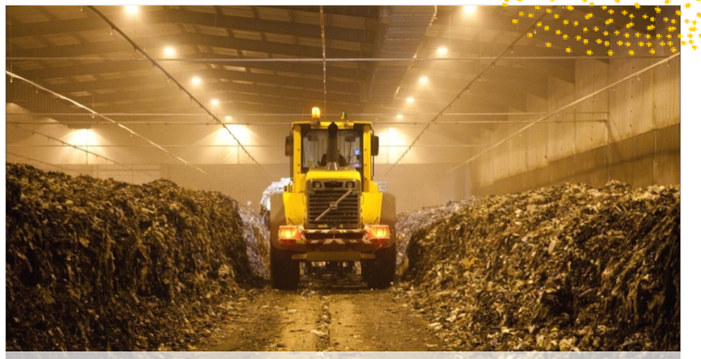


LANDFILL

A **landfill** is a secure site for disposal of waste under controlled operational and environmental conditions

INCINERATOR

An **incinerator** is a thermal recovery facility where waste is combusted under controlled operational and environmental conditions



Tunnel composter

Trommel screen used in mechanical recovery facilities

Anaerobic digestion facility

RECOVERY FACILITIES

Other **recovery facilities**, such as materials recovery facilities, composters, anaerobic digesters or mechanical biological treatment facilities extract materials, prepare fuels, or stabilise waste prior to disposal

Transfer Stations

- Facilities that interface between the collection and recovery/disposal systems.
- They can be included in large infrastructure investment projects, as a supporting component to improve logistics and reduce system costs

Combined transfer and materials recovery

- The informal recycling sector is very active in the Global South.
- Transfer stations can be combined with materials recovery facilities.

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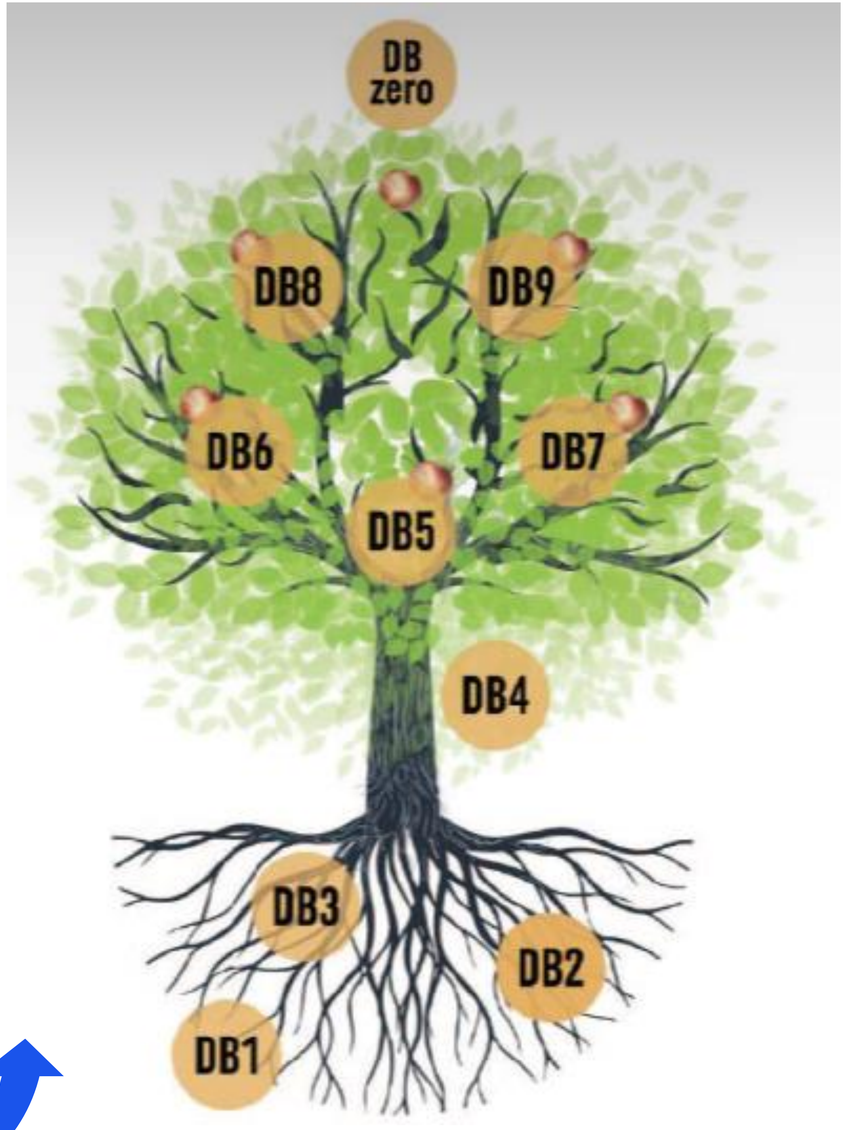
What are the SWM investment needs and priorities in the Global South?

The Nine Development Bands (9DBs)

- There are nine distinguished stages in developing waste management systems.
- Europe is leading waste management globally, with many countries settled into the upper branches
- In the Global South, the majority of cities are still in the ‘roots’ of the **tree.**



Source: Whiteman et al (2021): The Nine Development Bands at https://journals.sagepub.com/doi/full/10.1177/0734242X211035926

Opportunities and Challenges

Opportunities

- In the Global South, focus is on providing basic services – landfills
- MRF/Composting as recovery steps, but mainly at a lot level, involving informal sector
- There is an interest to treat waste to reduce disposal, but cost-wise it is still a challenge, looking at the low collection level

Challenges

- Institutional weaknesses
- Managerial capacities
- Financial potential
- Low waste collection efficiency
- Other pressing needs such as water supply, wastewater treatment, etc.

The Nine Development Bands (9DBs)

- **DB1**

  <30% collection, **0%** managed in controlled facilities.

- **DB2**

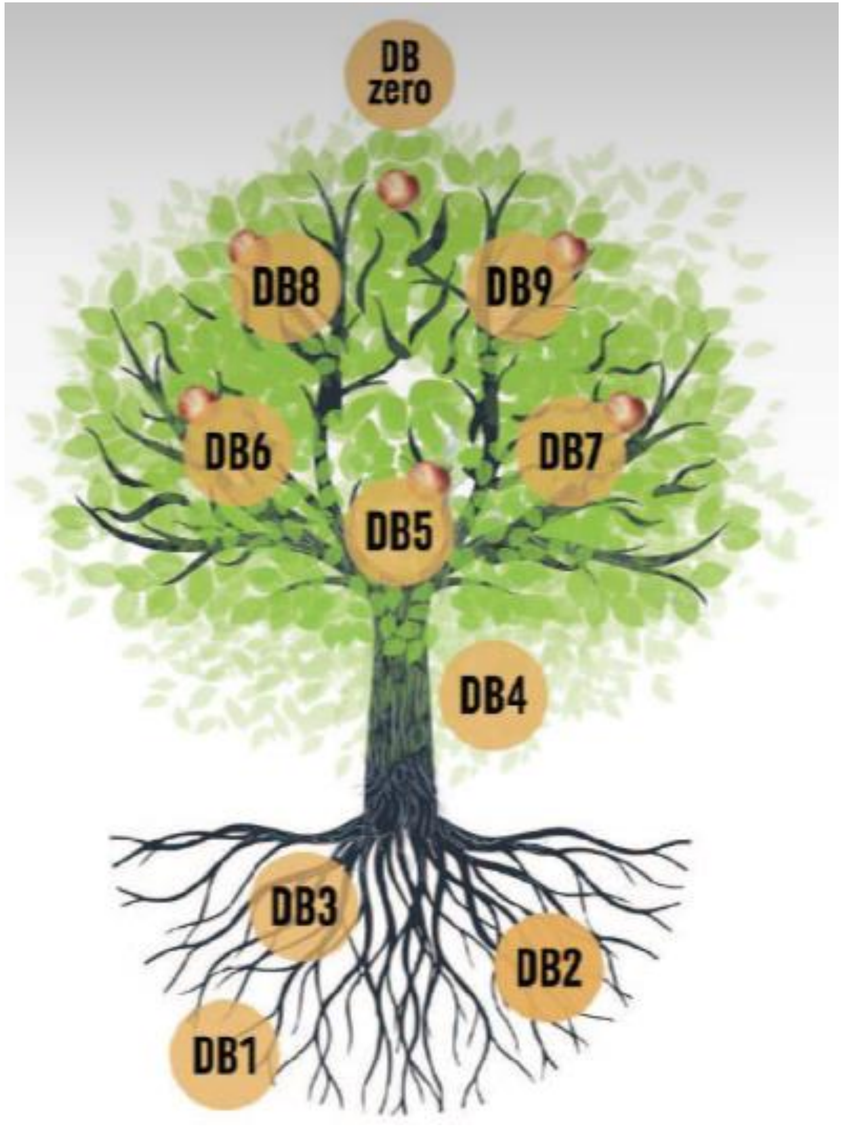
  <30-60% collection, **<20%** managed in controlled facilities.

- **DB3**

  <60-80% collection, **50%** managed in controlled facilities.

- **DB4**

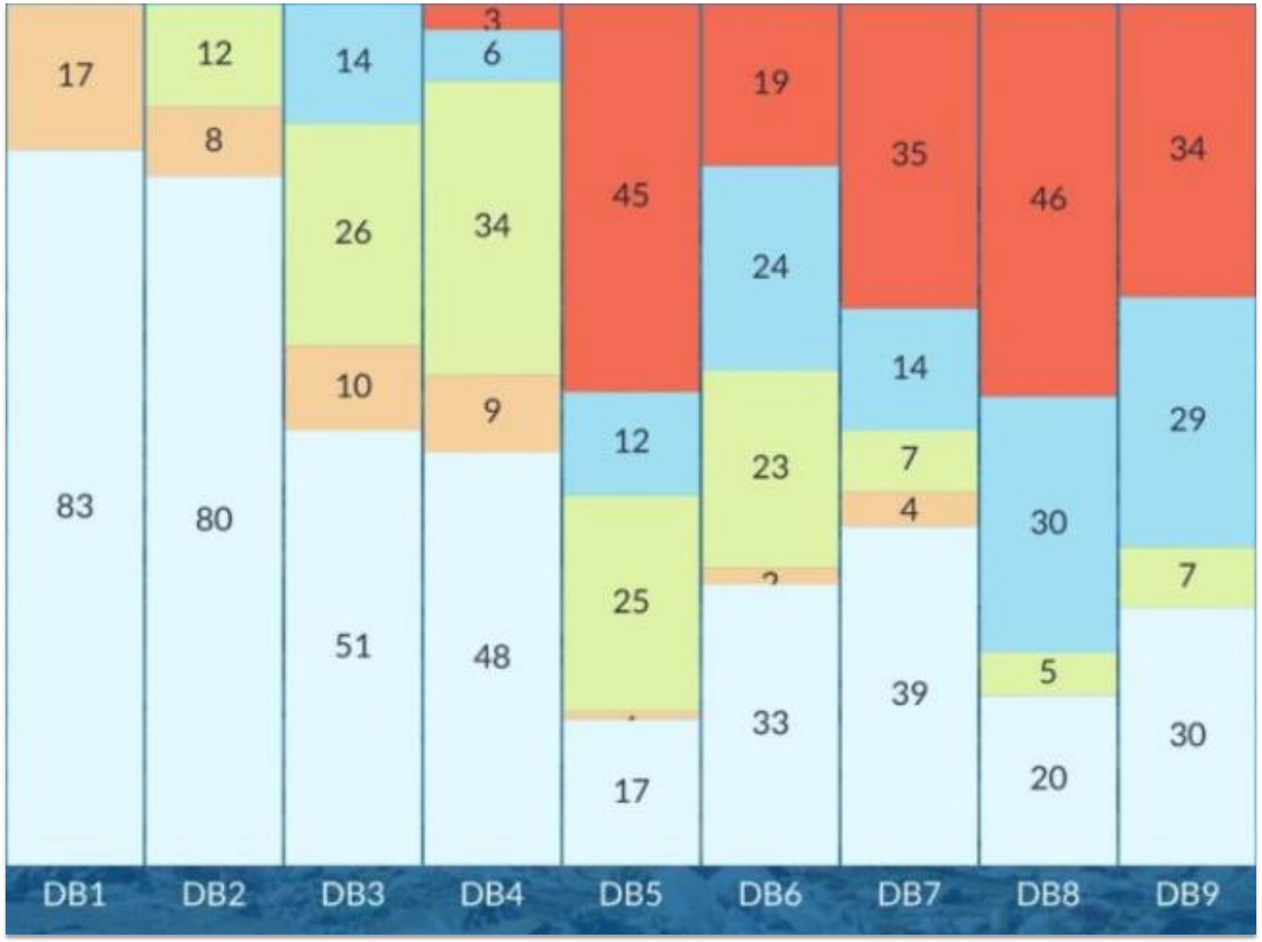
  <80-95% collection, **95%** managed in controlled facilities.



Source: Whiteman et al (2021): The Nine Development Bands at https://journals.sagepub.com/doi/full/10.1177/0734242X211035926

Percentage of Investment by Component

- Collection and Transfer
- Disposal upgrading and closure
- Regional facilities (**Landfill and composting**)
- Regional facilities (**MBT**)
- Regional facilities (**Thermal recovery**)



Source: Wasteaware at https://wasteaware.org/index.php/9dbs

City examples

DB	City, Country	Waste generation (t/d)	Collection service coverage	Managed in controlled facilities
1	**Kinshasa**, DRC	10,661	2%	1%
	Homa Bay, Kenya	76	26%	0%
2	**Dar es Salaam**, Tanzania	5,800	36%	1%
	Lagos, Nigeria	11,349	48%	8%
3	**Sekondi-Takoradi**, Ghana	165	61%	0%
	Cape Coast, Ghana	166	63%	0%
4	**Addis Ababa**, Ethiopia	2,178	94%	5%
	Dakar, Senegal	1,426	95%	1%

Critical needs at different development stages

DB1

Basic collection systems, early circular economy.

DB2

Expand collection, improve operational management at disposal sites.

DB3

Further expand collection, upgrade recovery and disposal facilities.

DB4

Extend to full collection coverage, ensure controlled management.

Quiz n.1

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Which SWM facilities offer the **greatest potential** for I
infrastructure projects in the Global South?

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Quiz n.2

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Mentimeter

When is the 'sweet spot' for **programming** large infrastructure projects?

<30% collection service coverage	30-60%	60-80%	80-95%	All of the above
0	0	0	0	0

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Deep Dive

Technical aspects of large infrastructure investments in SWM

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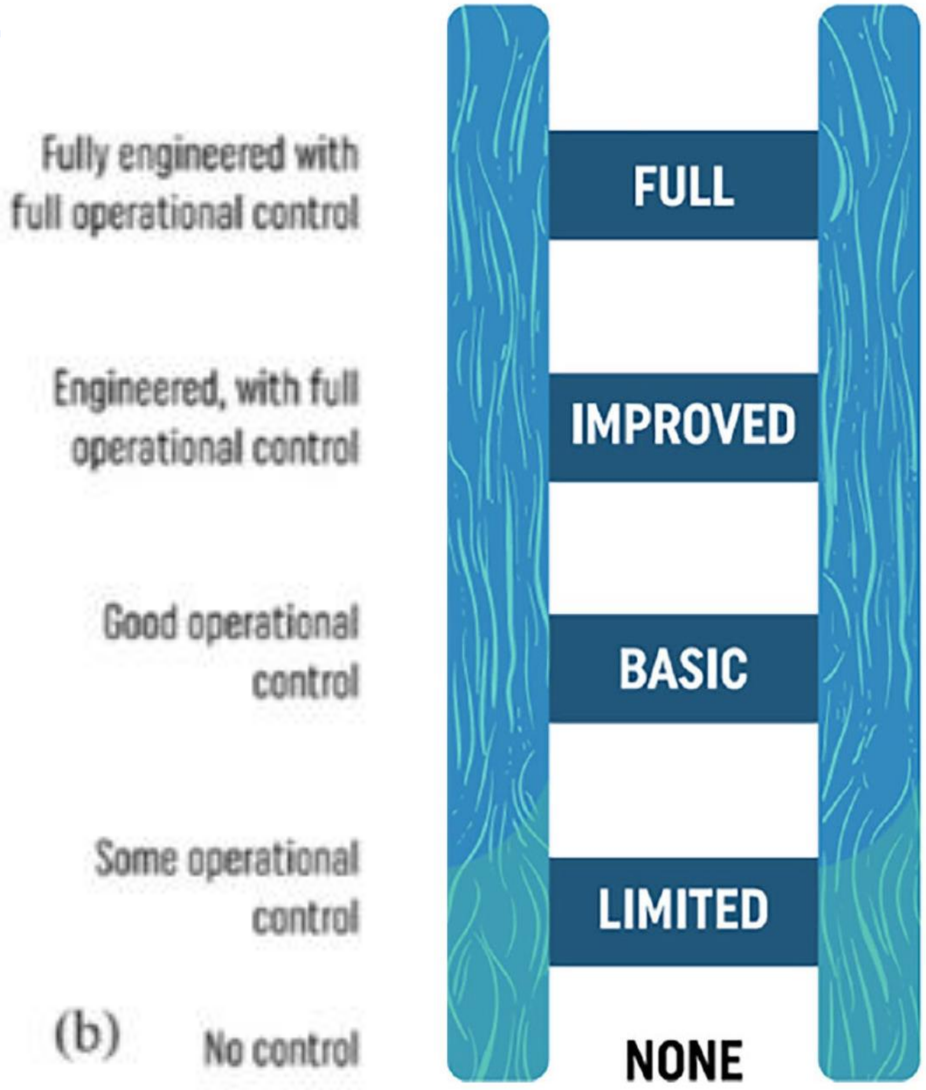
Landfill Standards

Why Landfills?

- **Uncontrolled disposal** is the standard practice in most countries in the Global South
- Whilst zero waste is a long-term goal, **safe disposal** will be needed in the **medium-long term**
- **Sanitary landfill** is the least costly environmentally sound management options
- Direct benefits include **job opportunities** and **energy** from landfill gas

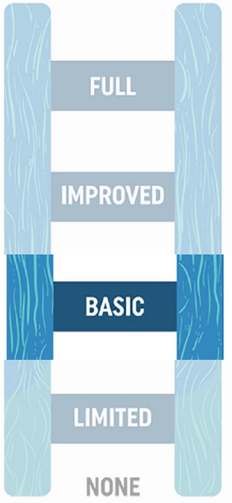


Disposal ‘ladder of control'

- European practice is Full control, or **Environmentally Sound Management (ESM)**
- These standards took many years of development to reach
- Need to focus also on upgrading existing disposal sites to basic control
- Then have momentum to move upwards in the ladder

Souce: //journals.sagepub.com/doi/10.1177/0734242X241262717

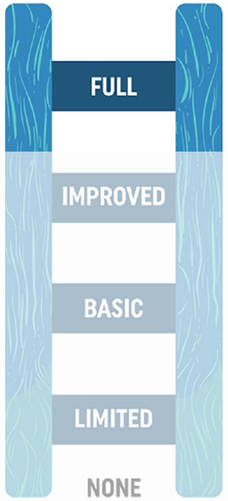
Basic controlled landfill



Basic Control	Security	» Boundary and access control allowing single point of supervised access
	Water control	» Perimeter drainage maintained around the site
	Slope stabilization	» Slopes stabilized, mitigating risk of landslides
	Waste handling, compaction and cover	» Waste trucks directed to specific operational area of disposal » Heavy mechanical equipment reliably available » Waste layered and compacted within the specific operational area » Some use of cover material
	Fire control	» Zero evidence of burning of waste on the surface of the landfill
	Staffing	» Site staffed during operational hours
	Recording	» Functional weighbridge in use
	EHS	» Basic personal protective equipment in use » Toilets and hand washing stations
	Site planning	» Site drawing showing landfill boundary and filling area in place

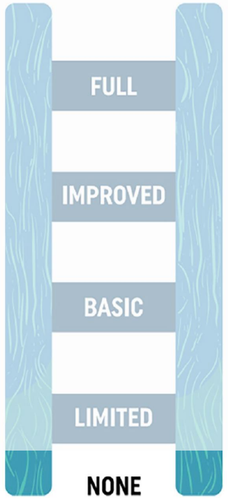
Source: Wasteaware at https://wasteaware.org/index.php/9dbs

Full control (ESM) landfill



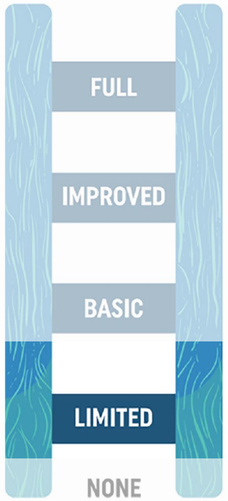
Full Control	Security	» Physical boundary surrounding the site and supervised access control 24/7
	Water and leachate control	» Site engineering preventing surface and groundwater ingress into the landfill » Functioning leachate containment and management
	Slope stabilization	» Slopes stabilized, including erosion control, to mitigate risk of landslide
	Waste handling, compaction and cover	» Waste deposited in clearly defined operational areas with strict management control » Waste layered and compacted promptly » Daily and intermediate cover applied
	Fire control	» Zero evidence of burning of waste on the surface of the landfill
	Landfill gas management	» Landfill gas controlled with utilization where practicable
	Staffing	» Site staffed full-time with professionally qualified personnel
	Recording	» Functional weighbridge in use with recording waste quantities by waste types
	Environment Health and Safety (EHS)_	» EHS measures implemented in accordance with professional risk assessment and operating plan » Showering and sanitary facilities » Environmental monitoring system in place with annual reporting capability
	Site planning	» Site development and operational filling plan in place » Post closure plan in place

Source: Wasteaware at https://wasteaware.org/index.php/9dbs



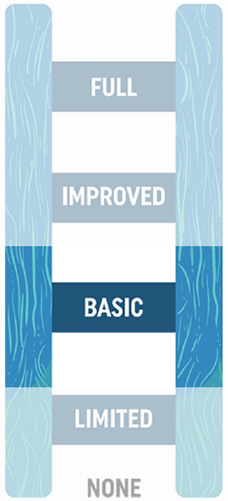
NO CONTROL:

- No staff.
- No layering or compacting.
- No weighing or recording of waste deliveries.
- No access control.
- Evidence of more than limited burning of waste.



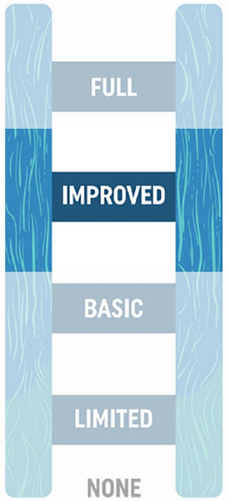
LIMITED CONTROL:

- Some compaction.
- Some compaction equipment.
- Some level of access control.
- Waste deliveries normally weighed and recorded.
- Minimal evidence of burning waste.



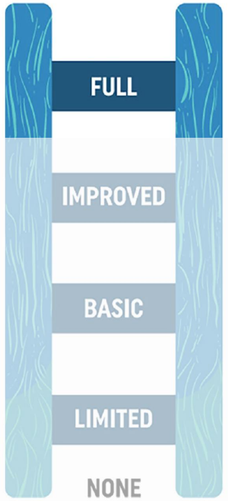
BASIC CONTROL:

- Some use of cover material.
- Waste compacted with equipment available.
- Site fenced with access control.
- Some level of containment.
- Some run-off/leachate control.
- Appropriately staffed.
- Waste deliveries routinely weighed and recorded.
- Basic EHS measures.
- Zero evidence of burning.



IMPROVED CONTROL:

- Some use of cover material.
- Waste compacted with equipment available.
- Site fenced with access control.
- Some level of containment.
- Some run-off/leachate control.
- Appropriately staffed.
- Waste deliveries routinely weighed and recorded.
- Basic EHS measures.
- Zero evidence of burning.



FULL CONTROL:

- Waste covered daily.
- Waste layered and compacted.
- Site fenced and gated.
- Base liner system installed.
- Leachate containment and treatment (on or off site)
- Landfill gas managed.
- Designed and functioning as a sanitary landfill.
- Fully staffed.
- Waste loads weighed & weight and source recorded.
- Environmental Health & Safety measures.
- Has / will have post closure plan.

Quiz n.3

Controlled or Uncontrolled?

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Landfill Siting and Design

Site Selection – In Theory

Ensure landfill is not on a restricted area:

- Floodplains/wetlands
- Highly permeable soils
- Ecologically sensitive zones
- Close to groundwater aquifers
- Fault areas/seismic impact zones
- Airport
- Access difficulty
- Proximity to populated areas
- Prime agricultural land

➡ Often very little options

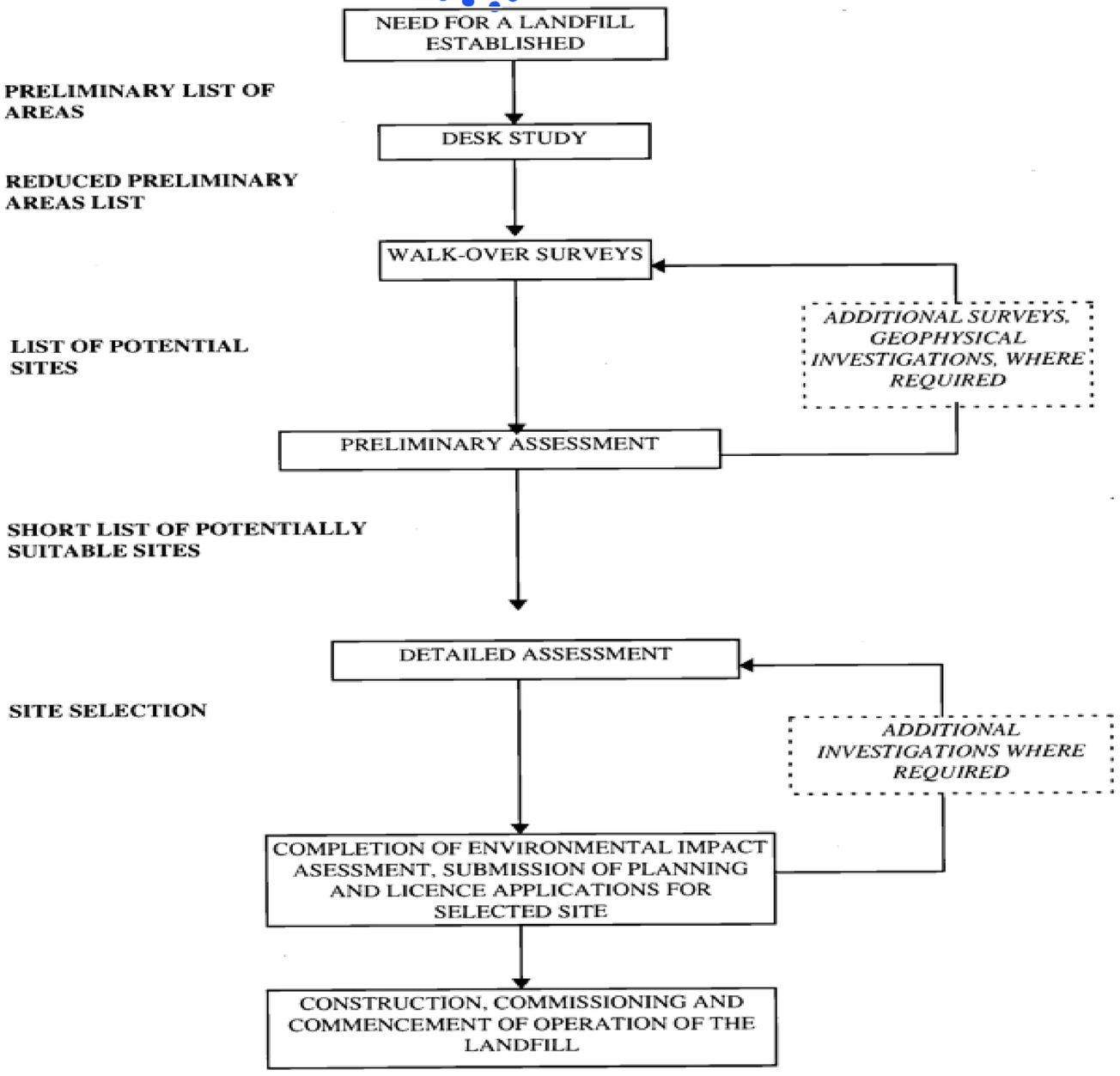


FIGURE 1: INVESTIGATIONS FOR A LANDFILL AND LINK TO SITE SELECTION

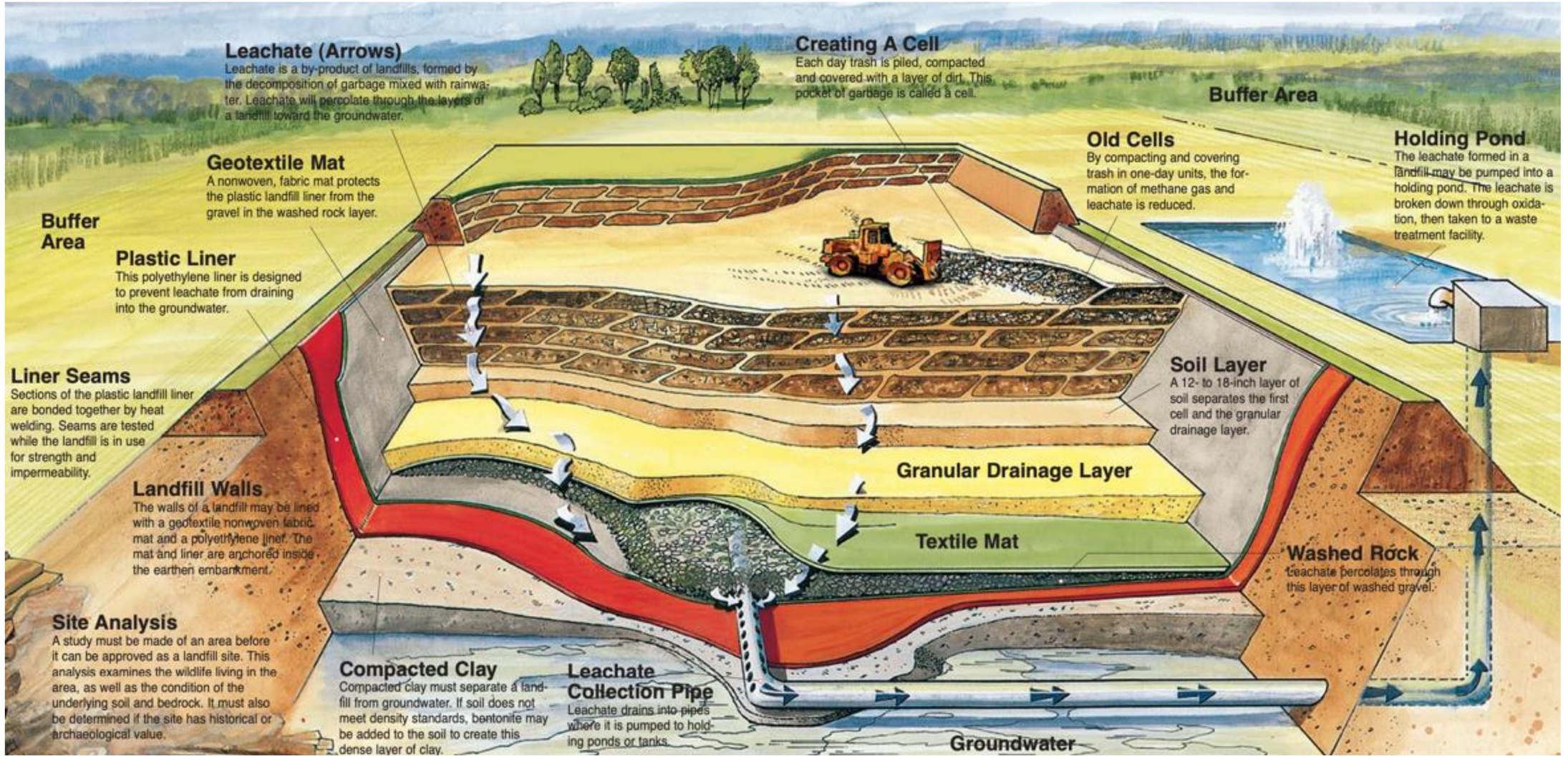
Site Selection – In Practice

- Prudent to build around where waste is already going, if sustainable.
- Improve existing operational and environmental conditions.
- Balance environmental and social considerations.
- Land availability is crucial, site might geologically be complex but easily available without causing social problems.

Often.....

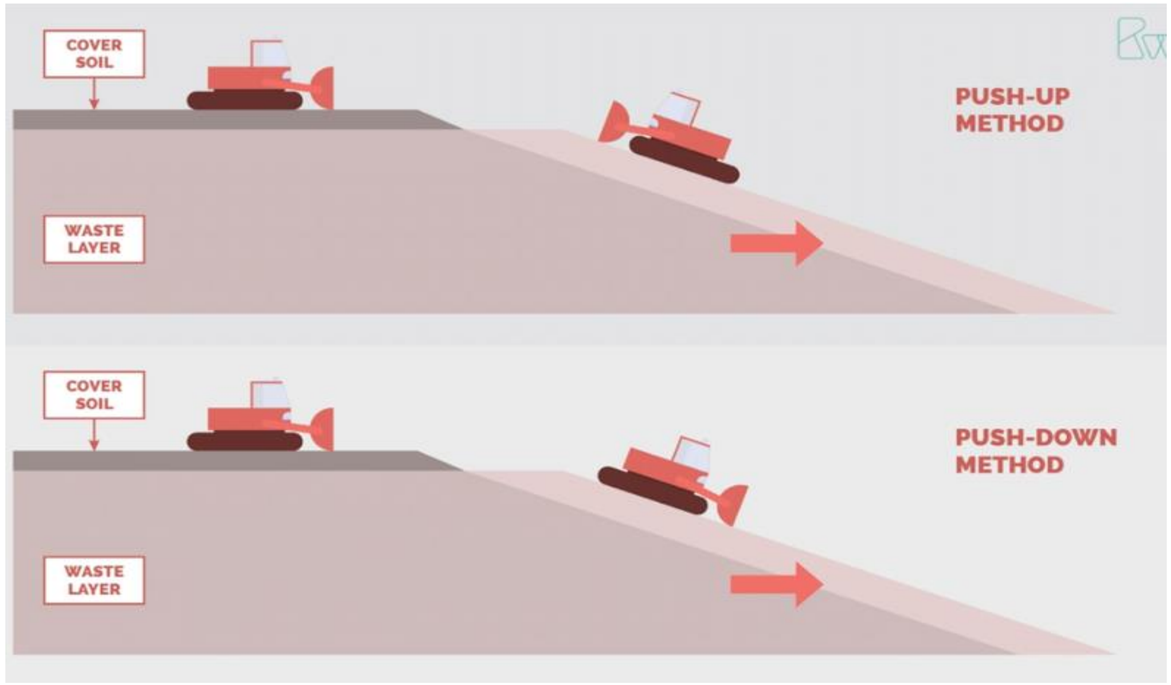
'The waste has already found its way'

European Standard Landfill



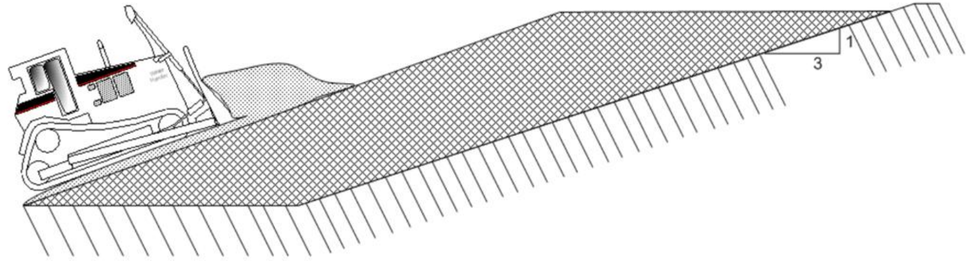
Source: Santek Environmental, 2024

Layering and compacting



Source: Santek Environmental, 2024

Covering of work face



Why?

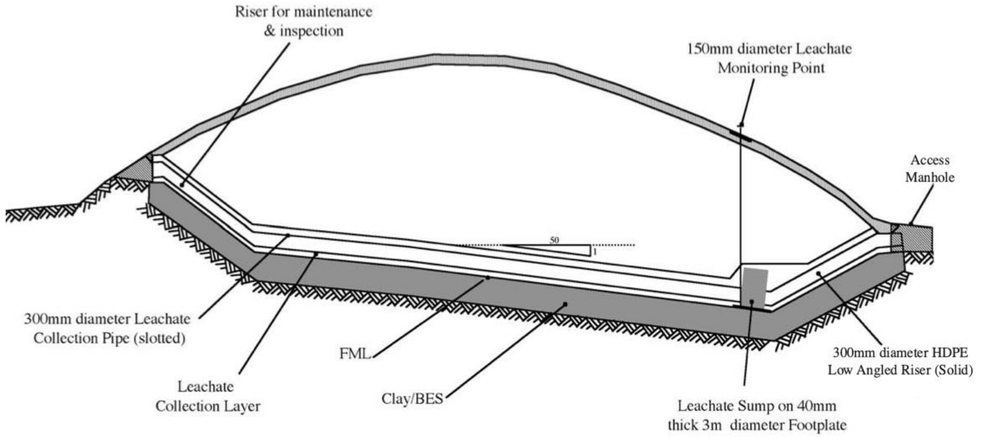
- To avoid littering by wind
- To avoid attraction by wind
- To avoid bad smell

Source: Santek Environmental, 2024

Leachate management

Includes:

- **Collection** – to minimise head of leachate above liner.
- **Removal** – to transport collected leachate to designated location.
- **Treatment** – to remove harmful contaminants before discharge.



Source: Santek Environmental, 2024

Leachate treatment

- Range of different treatment technologies
- Selection depends on standards, site design parameters, and climatic conditions

Source: Santek Environmental, 2024

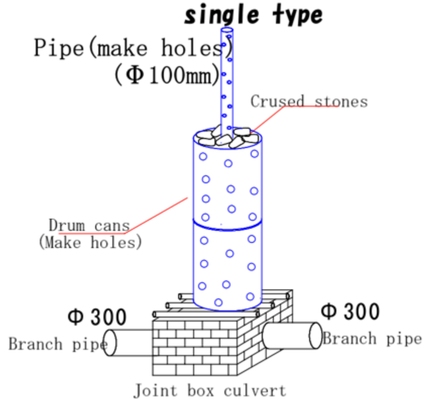
Landfill Gas Management

Passive or active systems exist

Benefits:

- Prevents gas build-up which may lead to combustion
- Minimise GHG emissions into atmosphere
- Minimise migration of gas beyond site
- Minimise damage to soil and vegetation

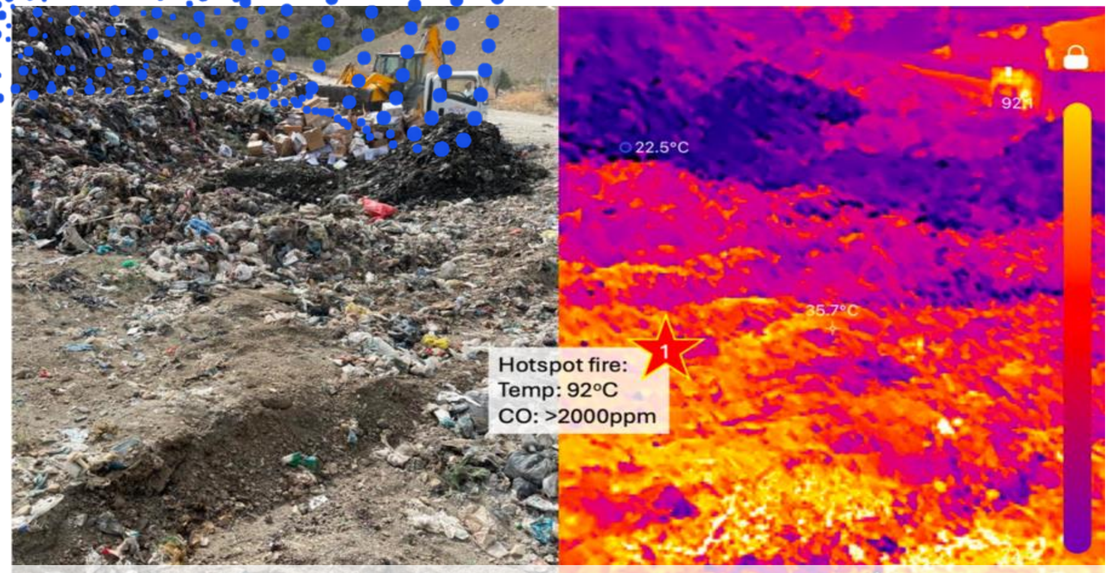
Gas vent (if utilisation/flaring not possible) © UN-Habitat



Gas collection © UN-Habitat

Gas utilisation © UN-Habitat

Health and Safety



Fire

Access and traffic control

Data collection

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Others
Recovery Facilities

Why waste recovery?

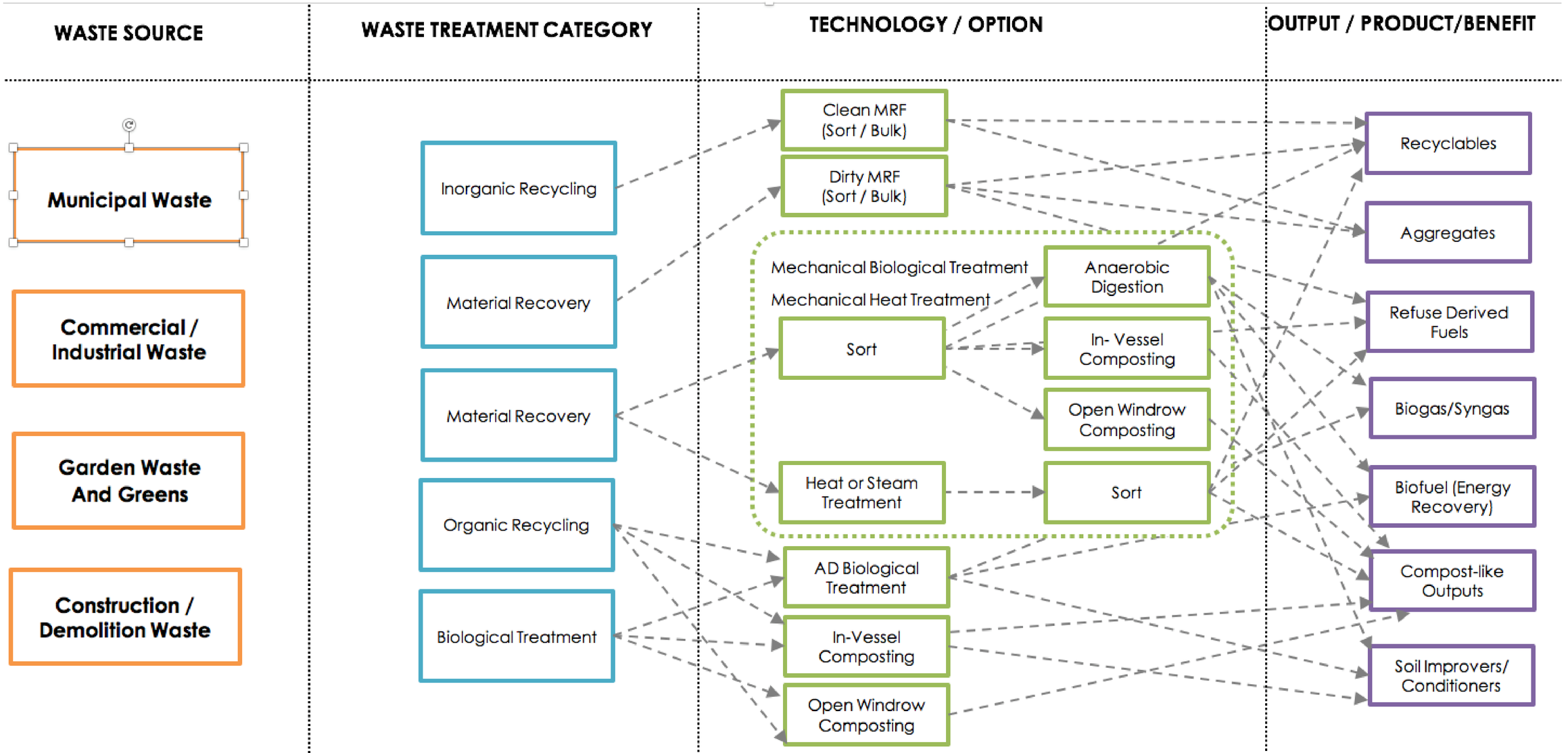
Circular Economy

Job Creation

Promoting Economy

Fuel/Energy Generation

Landfill Diversion


WASTE SOURCE
WASTE TREATMENT CATEGORY
TECHNOLOGY / OPTION
OUTPUT / PRODUCT/BENEFIT
Municipal Waste
Commercial / Industrial Waste
Garden Waste And Greens
Construction / Demolition Waste
Inorganic Recycling
Material Recovery
Material Recovery
Organic Recycling
Biological Treatment
Clean MRF (Sort / Bulk)
Dirty MRF (Sort / Bulk)
Mechanical Biological Treatment
Mechanical Heat Treatment
Sort
Heat or Steam Treatment
Anaerobic Digestion
In- Vessel Composting
Open Windrow Composting
Sort
AD Biological Treatment
In-Vessel Composting
Open Windrow Composting
Recyclables
Aggregates
Refuse Derived Fuels
Biogas/Syngas
Biofuel (Energy Recovery)
Compost-like Outputs
Soil Improvers/ Conditioners

Proven Recovery/Treatment Systems

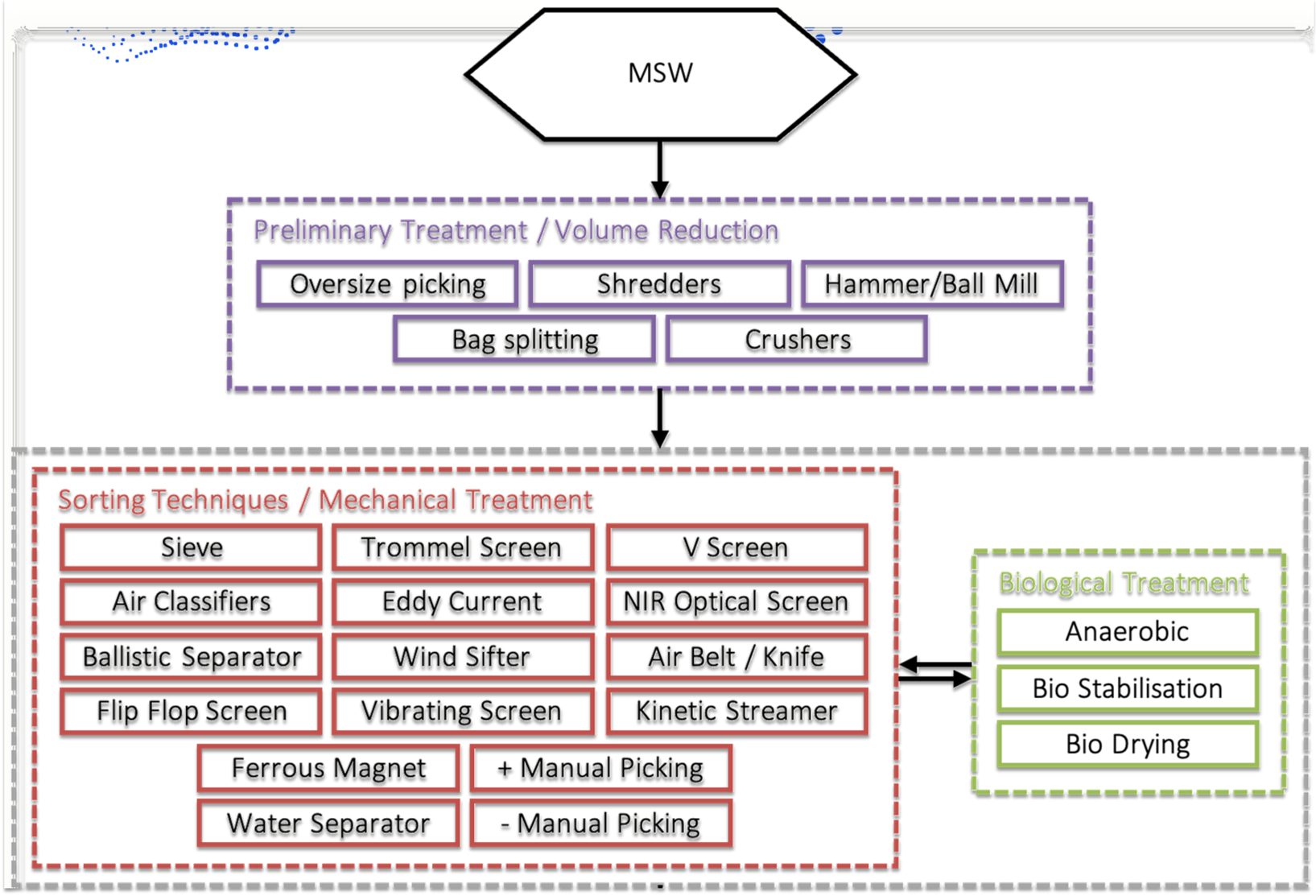
- Sorting/materials recovery for recyclables
- Composting of organic green waste for agricultural use
- Anaerobic digestion of wet organic waste to generate biogas for electricity or as liquified gas for transport and other pruposes

... can be combined into mechanical biological treatment (MBT) facilities

Mechanical Biological Treatment

Preliminary treatment

Sorting techniques

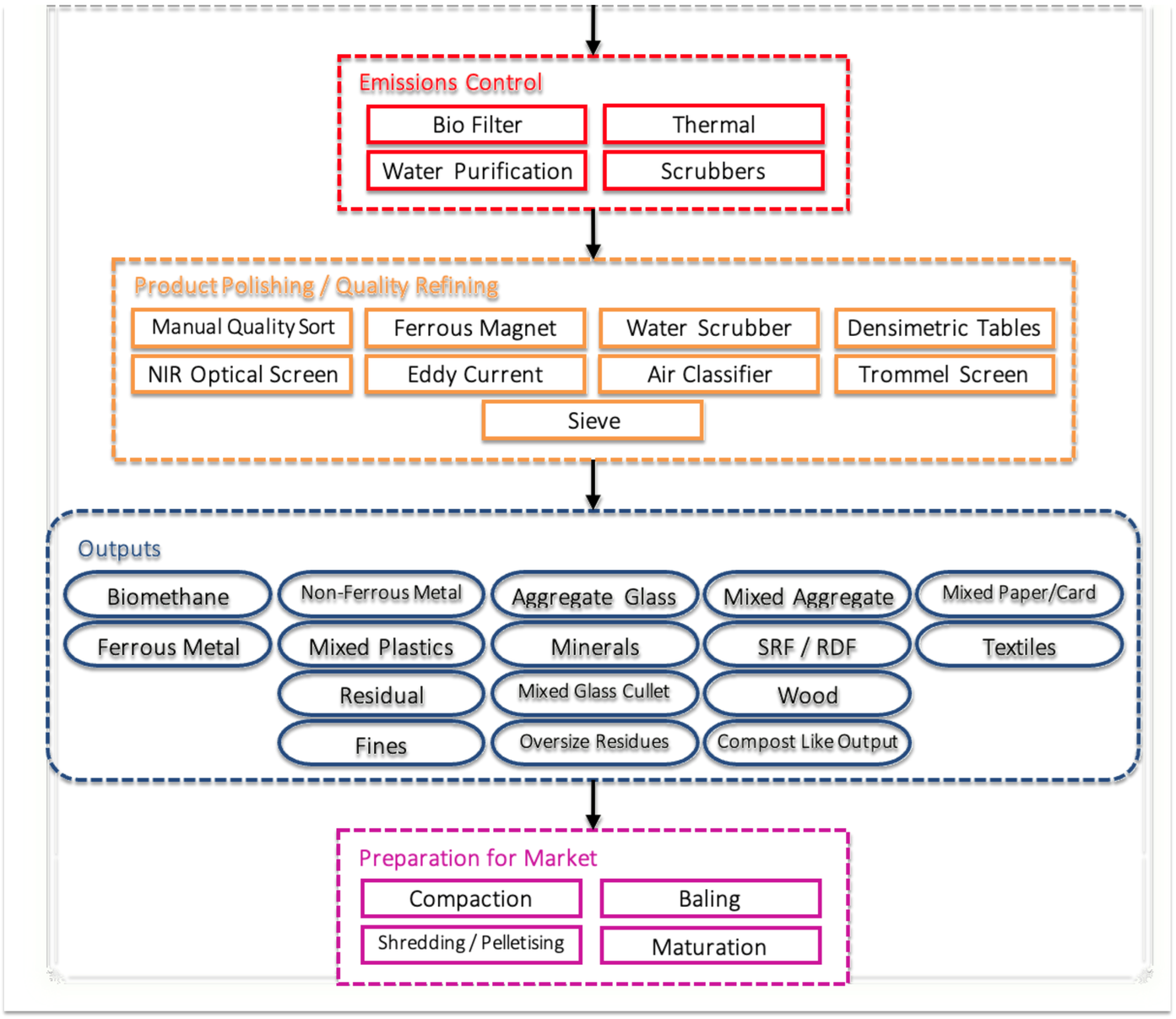


Emissions control

Product finishing

Outputs

Preparation for market



What and Where is the demand?

Feasibility of waste treatment plants (recovery of recyclables and other output) depends very much on the off-taker:

- **Recyclables**: Are there plastic producers, cardboard manufacturer, scrap dealer => proximity to harbours for export.
- **Refuse derived fuel - RDF**: Proximity of cement factories maximum of 50 – 100 km.
- **Biogas**: Feed-in conditions for electricity, gas grid for bio-methane, transport fuel, industry.
- **Compost like** output/Soil improvers/conditioners: need in agriculture.

Quiz n.4

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Mentimeter

Which of these types of recovery facility can generate fuel or energy?

Materials recovery facilities	Mechanical biological treatment facilities	Anaerobic digestors	Incinerators	All the above
0	0	0	0	0

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Data and Planning

Data and Large Investments

Types of data

- Generation Data
- Operational Data
- Financial Data
- Market Data

Practical use of data

- Planning and Design
- Optimization
- Preparation
- Policy and Strategy

Investment planning

- Database
- Option analysis
- Financing applications
- Budgeting processes
- KPIs

Baseline SWM data

Performance monitoring

Impact assessment

Source: https://rwm.global/

Waste Wise Cities Tool

Step 1: Preparation

Step 2: Household MSW Generation and Composition

Step 3: Non-Household MSW Generation

Step 4: MSW Received by Recovery Facilities and Control Level of Recovery Facilities

Step 5: MSW Received by Disposal Facilities and Control Level of Disposals Facilities

Step 6: Waste Composition at Disposal Facilities

Step 7: Calculating Food Waste, Recycling, Plastic Leakage, Greenhouse Gas Emissions and Air Pollution

Getting Started

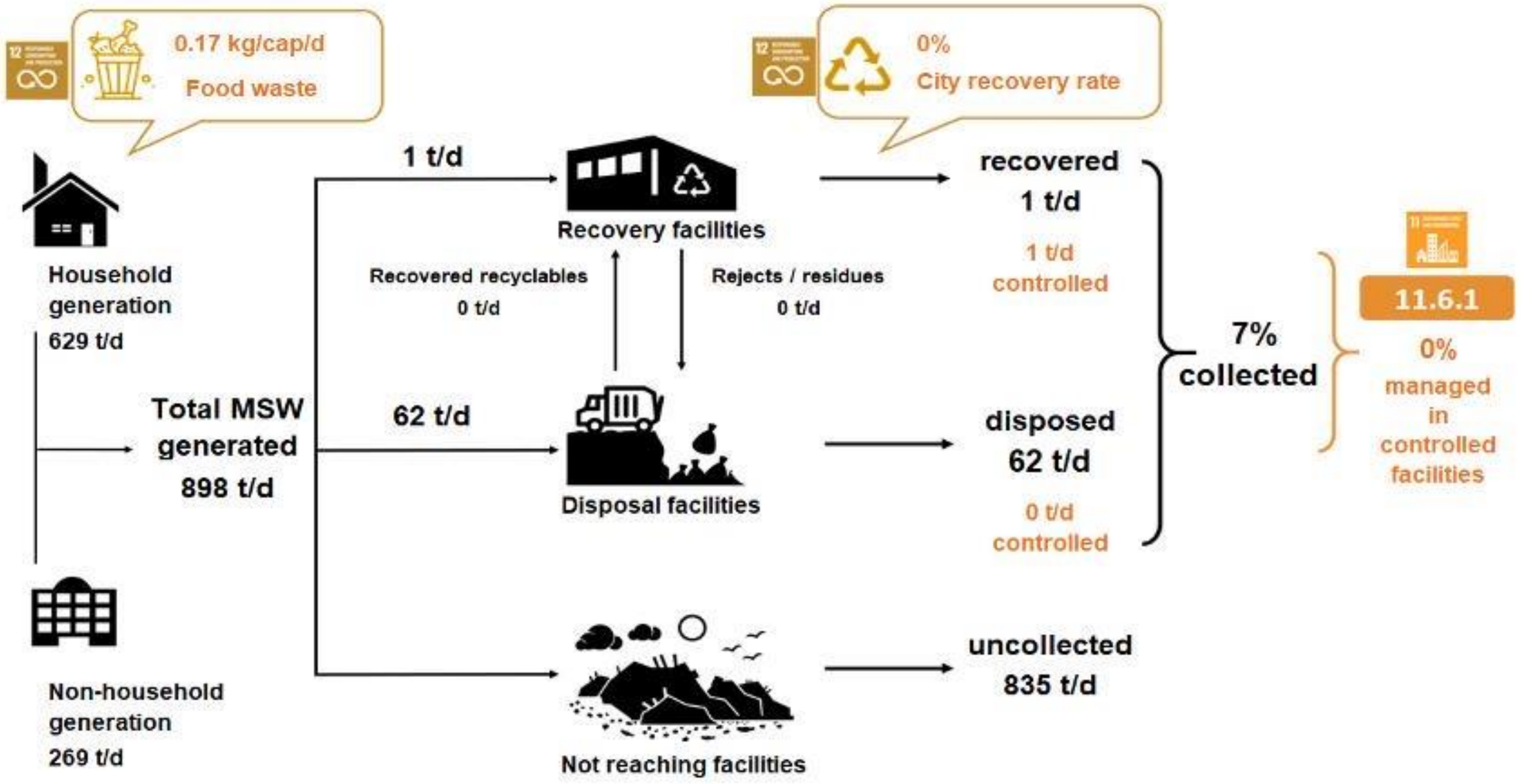
MSW Generation

MSW Recovery

MSW Disposal

Linkages with Other Important Indicators

What data do we get out of the WaCT?



Planning for sustainability

- **Make sure decisions are data-driven**
  - Establish a **Waste Information System** as a result of the data management approach
- Ensure **reasonable proximity** to offtake markets
- Right **balance of mechanical vs manual techniques**
- **Enhance managerial capacities** of the local administration to manage/administrate the investment
- Managing OPEX is crucial to sustainability
  - Improve financial

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Large Infrastructure Investments – Project Costs

Landfill investment scenarios

1. Upgrading	2. New site
Priorities: Build fencing Management of waste pickers Build access road Fire control measures Layout for potential gas and leachate migration Slope stabilisation Surface drainage Access to mechanical equipment Soil cover	**To do from scratch:** Site development (layout, preparation, materials, phasing, cells, bunding, cover material, landscaping) Site Infrastructure (Access and traffic control, accommodation, weighbridges, wheel cleaner, site services, security) Groundwater and surface water management Lining system Leachate management and treatment Landfill gas management Capping design and construction Health & Safety

‘No-regret’ investment

→ upgrade uncontrolled disposal sites to at least basic control.

→ While planning extensions or new sites

1. Upgrading	2. New site
Build fencing Management of waste pickers Build access road Fire control measures Layout for potential gas and leachate migration Slope stabilisation Surface drainage Access to mechanical equipment Soil cover	Site development (layout, preparation, materials, phasing, cells, bunding, cover material, landscaping) Site Infrastructure (Access and traffic control, accommodation, weighbridges, wheel cleaner, site services, security) Groundwater and surface water management Lining system Leachate management and treatment Landfill gas management Capping design and construction Health & Safety

Disposal site upgrading – CAPEX

Category	All in EURO Small-Scale	Medium-Scale	Large-Scale
Capping and Closure	100,000 - 300,000	300,000 - 1 million	1 million - 5 million+
Leachate Management	50,000 - 150,000	150,000 - 500,000	500,000 - 1 million+
Gas Venting and Treatment	50,000 - 100,000	100,000 - 300,000	300,000 - 1 million
Post-Closure Care	50,000 - 150,000 annually	150,000 - 500,000	500,000+
Total CAPEX (Rehabilitation)	**200,000 - 500,000**	**500,000 - 2 million**	**2 million - 7 million**

New/Extension landfill - CAPEX

Category	Small-Scale Landfill (25,000 – 50,000 t/a) 50 - 100 t/day	Medium-Scale Landfill (80,000 – 200,000 t/a) 200 - 400 t/day	Large-Scale Landfill (200,000 – 500,000 t/a) 500 – 1,500 t/day
Site Development	Basic site layout, preparation, bunding, covering.	More complex layout, leachate, gas systems.	Advanced systems, including gas recovery, energy generation.
Capping and Cover Systems	200,000 - 500,000	500,000 - 2 million	2 million+
Leachate Management	50,000 - 200,000	200,000 - 500,000	500,000 - 2 million+
Gas Management	50,000 - 150,000	150,000 - 500,000	500,000 - 1 million+
Environmental Monitoring	50,000 - 100,000	100,000 - 300,000	300,000 - 1 million
Total CAPEX (EUR)	**1 million - 3 million**	**3 million - 10 million**	**10 million - 50 million+**

All in EUR

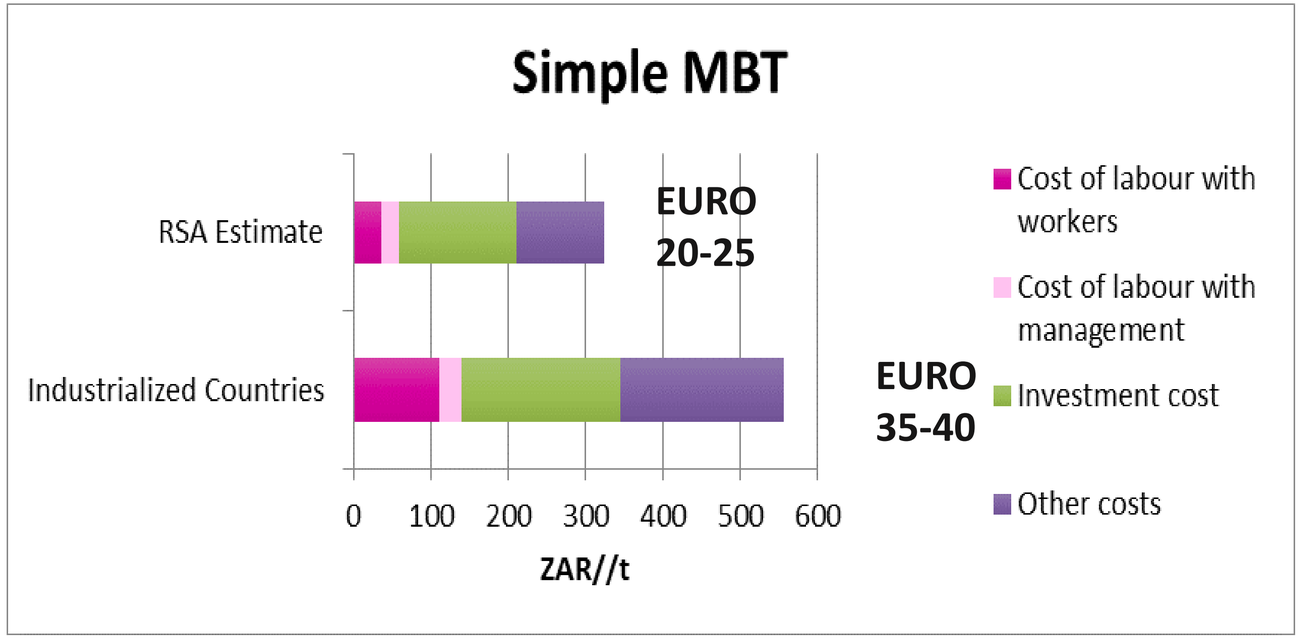
Source: RWA Group 2024

Waste Recovery Plants - CAPEX

Category	Small-Scale Facilities (25,000 – 50,000 t/a)	Medium-Scale Facilities (80,000 – 200,000 t/a)	Large-Scale Facilities (200,000 – 500,000 t/a)
Composting	Simple windrow composting 200,000 - 500,000	Aerated systems in-house or membrane covered 1,500,000 – 3,000,000	Inhouse, highly mechanized with biofilters 10,000,000 – 50,000,000
Material Recover Facilities	Manual sorting, small scale equipment 500,000 – 1,000,000	Some mechanical sorting equipment (drum, manual sorting belt, baler) 2 -3 million	Highly mechanized sorting with Near infrared scanner and others 3 million+
Mechanical-Biological Treatment (RDF)	-	Combination of mechanical conditioning and biological treatment (mechanized) 15 – 20 Million	Combination of mechanical conditioning and biological treatment (mechanized) 50 Million
Biodigestion	Mechanized systems, dry/wet fermentation 10 - 15,000,000	Highly mechanized, wet system 20 – 25,000,000	Not usual +50,000,000

All in EUR

Source: RWA Group 2024

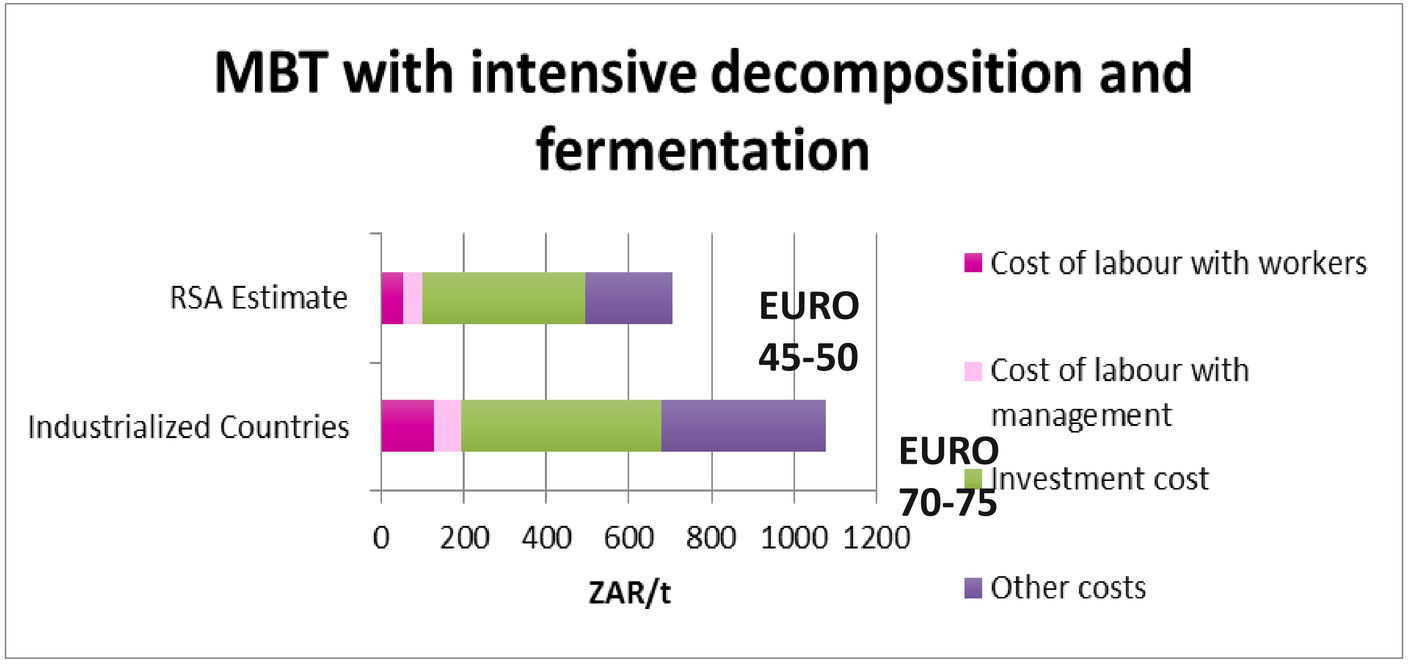


At that time Euro: ZAR exchange rate was about 15

MBT costs

Fixed vs variable costs

Source: KfW Advanced Integrated Waste Management Programme, 2016



Operating cost ranges

- Operation (and maintenance) budgets are key
- Costs increase with level of development
- Need to carefully balance goals setting with affordability considerations

	LOW-INCOME COUNTRIES	LOWER MIDDLE-INCOME COUNTRIES	UPPER-MIDDLE INCOME-COUNTRIES	HIGH-INCOME COUNTRIES
Collection and Transfer	18-47	28-70	47-94	84-188
Controlled Landfill to Sanitary Landfill	9-18	14-37	18-61	37-94
Open Dumping	1.8-7.5	2.8-9.4	-	-
Recycling	0-23	4.7-28	4.7-4.7	28-75
Composting	4.7-28	9-37	18-70	32-84

Table: Costs per tonnes (in EUR). Source: World Bank Solid Waste Community of Practice and Climate and Clean Air Coalition. Original costs in USD, converted to Euros at 2023 rates.

See more in INTPA F4, UDTF (2024). SWM Practical Advice Paper.

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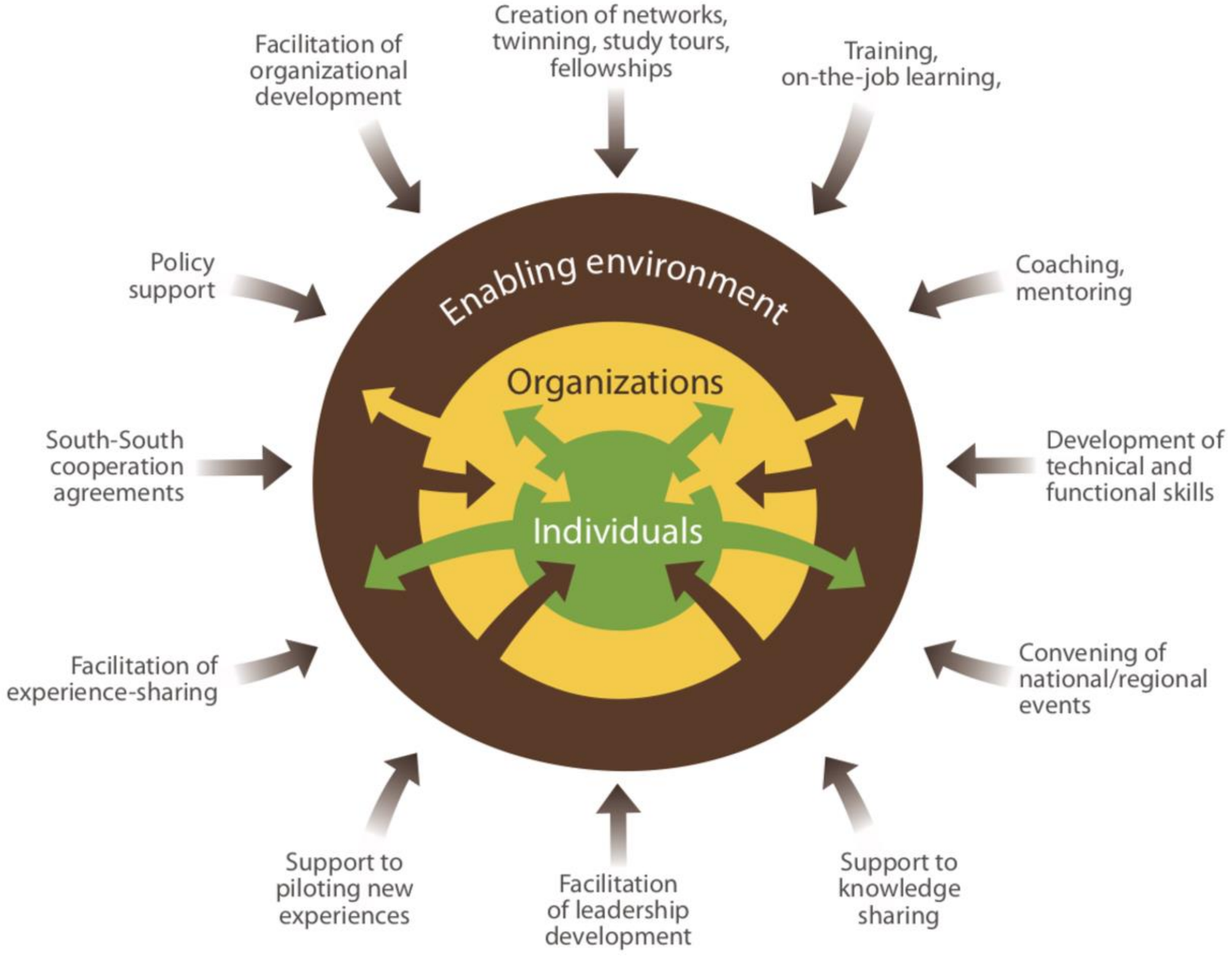
What does success rely upon?

Enabling framework

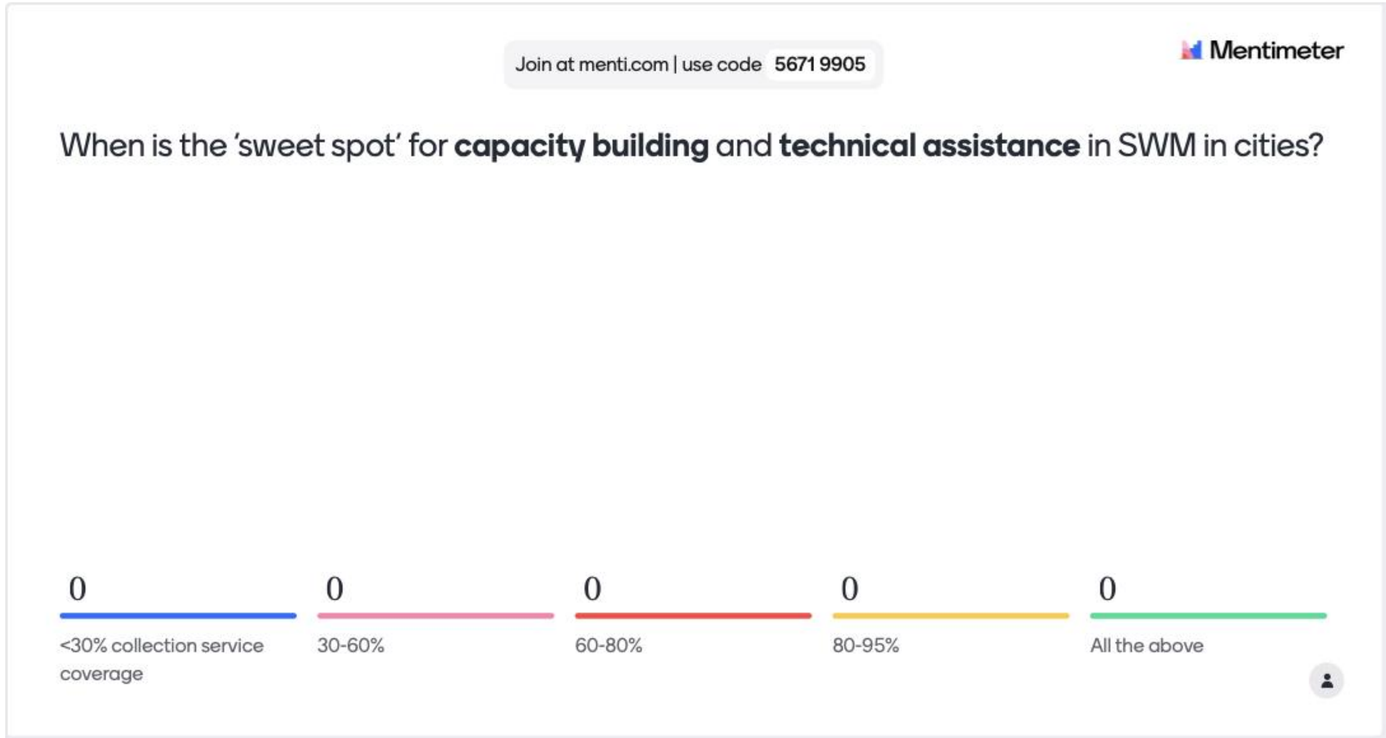
Large infrastructure investments need enabling framework conditions in place to be successful

- Policies and institutions
- Inclusivity
- Financial sustainability
- Legal/regulatory
- Institutional/organisational
- Planning
- Private sector participation
- International development partnerships

Capacity building



Quiz n.5


Join at menti.com | use code 5671 9905
Mentimeter
When is the 'sweet spot' for capacity building and technical assistance in SWM in cities?
0
<30% collection service coverage
0
30-60%
0
60-80%
0
80-95%
0
All the above

Topics Overview

Welcoming remarks.

1. **Conceptual Introduction.**
   - What are large infrastructure investments in SWM?
   - Large investment needs and priorities.

1. **Deep dive: Focus on Technical Aspects.**
   - Technical systems and facilities
   - Data and planning
   - Costs
   - What does success rely upon?

3. **Ask the Expert Session.**

50Kg compost sacs, 2021, Conakry, Guinea. Sanita villes propres, a European Union project implemented by Enabel (Belgian development agency).

Ask the Experts Session

Andrew Whiteman

Director, Resources and Waste Advisory Group

Bernhard Schenk

Solid Waste Management Expert

SWM Webinar Series Coordinator

Dear Participants:

- Please raise your hand, introduce yourself and ask your question.
- Ask your question to the experts.

* If you prefer to use the chat, please write a message: introduce yourself and ask your question.

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Thank you!

Please give us your opinion on the Webinar on SWM Large Infrastructure Investments.

Use the QR code or link:
https://forms.office.com/r/ZiXWQX4FtR

SWM Webinar 2: Large Infrastructure Investments

INTPA F4 - Urban Development Technical Facility UDTF.

The UDTF focuses on supporting partner countries in their urban development challenges. It delivers technical assistance and policy advice to improve the quality and impact of the EU's interventions in urban development at all levels - local, regional and global - with a focus on Africa, Asia, the Caribbean, and Latin America.